PRODUCT DESIGN AND DEVELOPMENT **Course Code : 315367**

Programme Name/s : **Mechanical Engineering/ Mechatronics/ Production Engineering**

Programme Code : **ME/ MK/ PG**

Semester : **Fifth**

Course Title : **PRODUCT DESIGN AND DEVELOPMENT**

Course Code : **315367**

I. RATIONALE

Design and development are two key elements necessary to create any product. From start to finish, each phase of the product's lifecycle needs careful coordination between these two disciplines for a successful outcome.Each organization should come with innovative ideas to bring up a new product, to maintain a top position in the market. Product design and development is a complete cycle to launch of new industrial products i.e from conceptualization to product realization.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use principles of product design and development for launching new products in the market.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Apply principles to develop new small industrial products according to customer's requirement for launching.
- CO2 - Use aesthetics and ergonomics principles for developing new products
- CO3 - Apply DFM principles for development of new product
- CO4 - Apply principles of QFD for Quality of new product
- CO5 - Use relevant rapid prototyping methods for development of new product along-with IPR process.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315367	PRODUCT DESIGN AND DEVELOPMENT	PDD	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the criteria of customer's need identification for designing new product. TLO 1.2 Explain principles of product design TLO 1.3 Explain product development process. TLO 1.4 State concept of product development TLO 1.5 Explain Seven step method for testing of product concept with example TLO 1.6 Explain process of implementing customer need for designing new product	**Unit - I Product Development** 1.1 Characteristics of successful product development, Customer need identification 1.2 Definition of product design, principles of good product design, Design by evolution, design by innovation 1.3 Product development process, Phases of process development. flow chart of product development. Tyco product development process 1.4 Concept development- different phases of concept development process, five step concept generation method, Concept classification tree, Concept combination table 1.5 Concept selection- Concept screening, Concept scoring, Seven step method for testing of product concept 1.6 Identification of customer need, Data collection from customer, organize collected data, Establishing relative importance of customer need for designing product with example	Lecture using media Lecture using Chalk-Board
2	TLO 2.1 Define product architecture TLO 2.2 Classify Modularity TLO 2.3 List different design considerations for machine controls using ergonomics principle. TLO 2.4 Apply relevant aesthetics and ergonomics principles in given situation. . TLO 2.5 List different aspects of aesthetics in product design	**Unit - II Product Architecture** 2.1 Definition of product architecture, Modular and Integral product architecture, its types, Component standardization, Steps for establishing the architecture with example like trailer, Spanners etc 2.2 Ergonomics- definition, necessity of ergonomics in product design. Design consideration for qualitative and quantitative display, Design considerations for controls like knob, levers, handwheel, toggle switch. 2.3 Aesthetics Principles- definition, necessity of aesthetics in product design, consideration of aesthetics in product design, Aspects of Aesthetics in Product Design - form, symmetry, color, continuity, proportion, contrast, impression, surface finish	Lecture using media Model Demonstration
3	TLO 3.1 State importance of Industrial design TLO 3.2 Explain term Design For Manufacturability (DFM) TLO 3.3 State necessity of Product Life Cycle TLO 3.4 Explain the procedure to determine 'Product Life Cycle' for given product.	**Unit - III Industrial Design** 3.1 Importance of industrial design, Industrial design process 3.2 Design for manufacturability (DFM), steps for DFM, design principles for manufacturability , Factors affect on DFM,.Impact of DFM on cost, quality and Time 3.3 Product Life Cycle- definition, importance, stages of Product life cycle, examples for determining product life cycle of Motorcycle, electrical vehicle etc	Lecture Using Chalk-Board Lecture ueing media

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Explain term Value engineering TLO 4.2 State procedure of Problem identification related to value engineering. TLO 4.3 State importance of QFD TLO 4.4 Explain QFD with suitable example. TLO 4.5 Draw House of Quality relationship Matrix for given product.	**Unit - IV Value Engineering** 4.1 Concept, Steps in value engineering, creative thinking, problem identification and value engineering job plan (VEJP). 4.2 Quality Function deployment (QFD) process-need, importance with example, symbols of QFD, voice of customer (VOC),VOC analysis, Quality QFD relationship matrix, roof ranking, Body ranking , importance of QFD 4.3 House of Quality linking customer complaints to technical requirements	Lecture Using Chalk-Board Case Study
5	TLO 5.1 List different types of Rapid prototyping TLO 5.2 Explain working and constructions of 3-D printer. TLO 5.3 Differentiate FDM and SLA 3 - D printer TLO 5.4 Overview of Patents and IPR (Intellectual Property Right) - Importance of patent, patent rights, criteria for patent, process for filing patents. TLO 5.5 Elaborate the benefits of Patent and IPR TLO 5.6 Explain procedure for filing patent.	**Unit - V Rapid Prototyping and Patent Filing** 5.1 Rapid Prototyping- concepts, principles of rapid prototyping, Types of Rapid Prototyping- Proof of concept prototype, Looks like prototype, Works like prototype 5.2 3-D printer types – Fused deposition Modeling (FDM), Stereolithography (SLA), Selective Laser sintering (SLS), construction and working-. Comparison between different types of 3-D printer 5.3 Planning for prototyping-steps for planning for prototyping, define purpose, establish level of approximation, experimental plan, schedule for procurement, production and testing 5.4 Patents and intellectual property- Importance of patent, patent rights, criteria for patent, process for filing patents.	Lecture using Chalk-Board Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Draw layout of Simple product evolution diagram	1	*Layout of simple product evolution diagram	2	CO1
LLO 2.1 Draw diagram of existing bench available in the classroom. LLO 2.2 Apply ergonomics principle to classroom bench LLO 2.3 Draw diagram of modified / developed bench using ergonomic principle.	2	*Development of existing Classroom bench/Chair/Drawing table/Laboratory table using relavant ergonomics principles.	4	CO2
LLO 3.1 Draw sketch of any component available in the laboratory LLO 3.2 Apply aesthetic principles to the development of a given product. LLO 3.3 Draw sketch of modified product	3	Development of product using aspects of aesthetics in product designing	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Select any simple product from Market LLO 4.2 Apply DFM principle for development of identified product as per requirement LLO 4.3 Write a report of identified product using DFM	4	Draw flow chart for accepting design of new product using DFM principle	2	CO3
LLO 5.1 Collect specification of bicycle using manufacturer's catalogue. LLO 5.2 Determine product life cycle of identified bicycle LLO 5.3 Draw product life cycle diagram of identified bicycle	5	*Determination of product life cycle of Bicycle	2	CO2 CO3
LLO 6.1 Draw Roof and Body of House of Quality. LLO 6.2 Prepare questionnaire for customers/users to know technical requirements. LLO 6.3 Apply principles of QFD for drawing House of Quality. LLO 6.4 Draw House of Quality diagram for given product	6	*Build House of Quality for steel cupboard / computer bench/ furniture available in the laboratory	4	CO1 CO4
LLO 7.1 Draw diagram of developed product LLO 7.2 Produce prototype of developed product	7	Development of prototype of any simple object using cardboard/plywood etc	2	CO1 CO2 CO5
LLO 8.1 Draw flow chart for filing a patent using Governemnt website	8	* Draw flow chart for filing patent (IPR act 2005)for given product usiing Government of India website.	2	CO5
LLO 9.1 Develop model using solid modeling software	9	Use of 3-D printer	4	CO1 CO5
LLO 10.1 Draw diagram of identified product LLO 10.2 Produce prototype of identified product	10	Development of prototype of any identified product from the market	2	CO1 CO2 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Activity based on voice of customer

- Prepare a brief report based on voice of customer through survey

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	3 D printer (FDM)- size- 200x200x250 mm, layer resolution 0.08 mmto 0.4 mm,print speed 40-120 mm/sec,Nozzle size 0.4mm,Filament- ABS/PLA/Composit	12,13
2	Computer systems and peripherials-2GB RAM,CPU1GHz,Disk Space-1.2 GB for 64 bit platform,OS ,minimum .single core ,Graphic card, sound card	All
3	Solid Modeling software such as Creo,Solid Edge, Solid works or equivalent	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Product Development	CO1	9	4	4	8	16
2	II	Product Architecture	CO2	6	2	4	6	12
3	III	Industrial Design	CO3	9	4	4	8	16
4	IV	Value Engineering	CO4	10	4	4	8	16
5	V	Rapid Prototyping and Patent Filing	CO5	6	2	2	6	10
Grand Total				**40**	**16**	**18**	**36**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Mid term tests Rubrics for COs Assignment, Self-learning and Terms work Seminar/Presentation

Summative Assessment (Assessment of Learning)

- End of Term Examination Viva-voce Lab. performance

XI. SUGGESTED COS - POS MATRIX FORM

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Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	-	2	3	-	2	2	3			
CO2	-	-	3	-	2	3	3			
CO3	-	2	-	-	2	2	3			
CO4	-	2	2	-	-	3	3			
CO5	-	-	-	2	2	3	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	K.T.Ulrich	Product Design and Development	6th edition, McGrawhill Publication, 2023 ISBN 9780071086950
2	A.K.Chitale, R.C.Gupta	Product Design and Manufacturing	7th edition, PHI publication 2023, ISBN-13-978-9391818722
3	Richard Morris	Fundamentals of Product Design	2nd edition,2023, Bloomsbury Visual Arts Publication, ISBN 13- 978-1350398856
4	M.M.Soreas	Ergonomics in Design	1st edition,2016 CRC Press Publication, ISBN13- 978-0367356903

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL lecture on product design steps and analysis
2	https://www.youtube.com/watch?v=mqC4Wn_OK-I	Value engineering
3	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Ergonomics for Product Design
4	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on QFD
5	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Functional Analysis Technique
6	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Rapid Prototyping
7	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on Rapid Prototyping Processes
8	https://www.youtube.com/watch?v=dYPW5Rlwn8g	Working of 3 D printer
9	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL lecture on product life cycle
10	https://www.youtube.com/watch?v=X1KONQw02H8	Quality of House
11	https://www.youtube.com/watch?v=Lo-AFCv2ggE	Product design and development
12	https://onlinecourses.nptel.ac.in/noc21_me83/preview	NPTEL lecture on product design and development
13	https://www.youtube.com/watch?v=iRMsd-X_e-0	QFD Analysis
14	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL Lecture on VEJP
15	https://archive.nptel.ac.in/courses/112/107/112107217/	NPTEL lecture on Value engineering Concepts

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Sr.No	Link / Portal	Description

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students